

WHAT IS CLAIMED IS:

1 1. A method of recovering data in a database of a database system stored in a
2 datastore connected to a computer, the method comprising:

3 scanning a database log, wherein the database log records activities related to the
4 database; and

5 identifying one or more individual objects to be recovered to a target time with
6 reference to a backup time.

1 2. The method of claim 1, wherein the target time is user-defined.

1 3. The method of claim 1, wherein the backup time is user-defined.

1 4. The method of claim 1, further comprising analyzing the database log to
2 detect when a unit of recovery begins and when the unit of recovery ends.

1 5. The method of claim 4, wherein an object is not recovered when the unit of
2 recovery accessing that object ends before the target time and there are no pending writes for
3 the object.

1 6. The method of claim 5, wherein the unit of recovery begins and ends before a
2 checkpoint time, and wherein the checkpoint time occurs before the target time.

1 7. The method of claim 5, wherein the unit of recovery begins before a
2 checkpoint time, and wherein the unit of recovery ends after the checkpoint time but before
3 the target time.

1 8. The method of claim 5, wherein the unit of recovery begins after a checkpoint
2 time, and wherein the unit of recovery ends before the target time.

1 9. The method of claim 4, wherein an object is recovered if the unit of recovery
2 begins before the target time, and wherein the unit of recovery ends after the target time but
3 before a current time, wherein the current time represents when object data is recorded to the
4 database.

1 10. The method of claim 9, wherein the unit of recovery begins before a
2 checkpoint time.

1 11. The method of claim 9, wherein the unit of recovery begins after a checkpoint
2 time but before the target time.

1 12. The method of claim 4, wherein an object is recovered if the unit of recovery
2 begins after the target time, and wherein the unit of recovery ends before a current time,
3 wherein the current time represents when object data is recorded to the database.

1 13. The method of claim 1, wherein a backup is taken.

1 14. The method of claim 13, wherein the backup occurs prior to the target time
2 and further comprising restoring data without restoring the database log.

1 15. The method of claim 13, wherein the backup occurs after the target time and
2 further comprising restoring data and optionally restoring the database log.

1 16. The method of claim 13, further comprising restarting the database system
2 with a conditional restart with defer all option.

1 17. The method of claim 1, further comprising flushing cache data to disk.

1 18. The method of claim 1, further comprising truncating the database log at the
2 target time.

1 19. The method of claim 18, further comprising disabling access to the database
2 and restarting the database system, wherein restarting detects uncommitted units of recovery.

1 20. The method of claim 19, further comprising creating a compensation log and
2 appending the compensation log to the truncated database log beginning from the target time.

1 21. The method of claim 1, further comprising restoring the identified objects.

1 22. The method of claim 21, further comprising determining whether the database
2 log should be applied to the restored objects to update the identified objects with current
3 object data.

1 23. The method of claim 22, when the determination is made to apply the
2 database log to the identified objects, further comprising optimizing the identified objects
3 such that the identified objects may be restored without applying the database log to the
4 identified objects.

1 24. The method of claim 23, if the objects can not be optimized, applying the
2 database log to the restored objects.

1 25. The method of claim 21, after restoring the identified objects, further
2 comprising providing access to the identified objects.

1 26. The method of claim 1, further comprising optimizing the identified objects
2 by restoring a volume of the datastore and recovering corresponding objects.

1 27. The method of claim 1, further comprising optimizing the identified objects
2 by grouping the identified objects, wherein the grouped objects have backups residing on the
3 same volume of the datastore.

1 28. The method of claim 1, wherein an object is associated with different units of
2 recovery, wherein one or more units of recovery require different levels of processing, and
3 wherein the object is recovered utilizing the highest level of processing.

1 29. The method of claim 1, wherein the one or more individual objects to be
2 recovered to a target time are recovered from a current time.

1 30. The method of claim 29, wherein the current time represents at time at which
2 the database system crashed.

1 31. An apparatus for recovering data in a database of a database system,
2 comprising:
3 a computer having a data store connected thereto, wherein the data store stores data;
4 and
5 one or more computer programs, performed by the computer, for scanning a database
6 log, wherein the database log records activities related to the database and for identifying one
7 or more individual objects to be recovered to a target time with reference to a backup time.

1 32. The apparatus of claim 31, wherein the target time is user-defined.

1 33. The apparatus of claim 31, wherein the backup time is user-defined.

1 34. The apparatus of claim 31, further comprising analyzing the database log to
2 detect when a unit of recovery begins and when the unit of recovery ends.

1 35. The apparatus of claim 34, wherein an object is not recovered when the unit of
2 recovery accessing that object ends before the target time and there are no pending writes for
3 the object.

1 36. The apparatus of claim 35, wherein the unit of recovery begins and ends
2 before a checkpoint time, and wherein the checkpoint time occurs before the target time.

1 37. The apparatus of claim 35, wherein the unit of recovery begins before a
2 checkpoint time, and wherein the unit of recovery ends after the checkpoint time but before
3 the target time.

1 38. The apparatus of claim 35, wherein the unit of recovery begins after a
2 checkpoint time, and wherein the unit of recovery ends before the target time.

1 39. The apparatus of claim 34, wherein an object is recovered if the unit of
2 recovery begins before the target time, and wherein the unit of recovery ends after the target
3 time but before a current time, wherein the current time represents when object data is
4 recorded to the database.

1 40. The apparatus of claim 39, wherein the unit of recovery begins before a
2 checkpoint time.

1 41. The apparatus of claim 39, wherein the unit of recovery begins after a
2 checkpoint time but before the target time.

1 42. The apparatus of claim 34, wherein an object is recovered if the unit of
2 recovery begins after the target time, and wherein the unit of recovery ends before a current
3 time, wherein the current time represents when object data is recorded to the database.

1 43. The apparatus of claim 31, wherein a backup is taken.

1 44. The apparatus of claim 43, wherein the backup occurs prior to the target time
2 and further comprising restoring data without restoring the database log.

1 45. The apparatus of claim 43, wherein the backup occurs after the target time and
2 further comprising restoring data and optionally restoring the database log.

1 46. The apparatus of claim 43; further comprising restarting the database system
2 with a conditional restart with defer all option.

1 47. The apparatus of claim 31, further comprising flushing cache data to disk.

1 48. The apparatus of claim 31, further comprising truncating the database log at
2 the target time.

1 49. The apparatus of claim 48, further comprising disabling access to the database
2 and restarting the database system, wherein restarting detects uncommitted units of recovery.

1 50. The apparatus of claim 49, further comprising creating a compensation log
2 and appending the compensation log to the truncated database log beginning from the target
3 time.

1 51. The apparatus of claim 31, further comprising restoring the identified objects.

1 52. The apparatus of claim 51, further comprising determining whether the
2 database log should be applied to the restored objects to update the identified objects with
3 current object data.

1 53. The apparatus of claim 52, when the determination is made to apply the
2 database log to the identified objects, further comprising optimizing the identified objects
3 such that the identified objects may be restored without applying the database log to the
4 identified objects.

1 54. The apparatus of claim 53; if the objects can not be optimized, applying the
2 database log to the restored objects.

1 55. The apparatus of claim 51, after restoring the identified objects, further
2 comprising providing access to the identified objects.

1 56. The apparatus of claim 31, further comprising optimizing the identified
2 objects by restoring a volume of the datastore and recovering corresponding objects.

1 57. The apparatus of claim 31, further comprising optimizing the identified
2 objects by grouping the identified objects, wherein the grouped objects have backups residing
3 on the same volume of the datastore.

1 58. The apparatus of claim 31; wherein an object is associated with different units
2 of recovery, wherein one or more units of recovery require different levels of processing, and
3 wherein the object is recovered utilizing the highest level of processing.

1 59. The apparatus of claim 31, wherein the one or more individual objects to be
2 recovered to a target time are recovered from a current time.

1 60. The apparatus of claim 59, wherein the current time represents at time at
2 which the database system crashed.

1 61. An article of manufacture comprising a computer program carrier readable by

2 a computer and embodying one or more instructions executable by the computer for
3 recovering data in a database of a database system, comprising:
4 scanning a database log, wherein the database log records activities related to the
5 database; and
6 identifying one or more individual objects to be recovered to a target time with
7 reference to a backup time.

1 62. The article of manufacture of claim 61, wherein the target time is user-
2 defined.

1 63. The article of manufacture of claim 61, wherein the backup time is user-
2 defined.

1 64. The article of manufacture of claim 61, further comprising analyzing the
2 database log to detect when a unit of recovery begins and when the unit of recovery ends.

1 65. The article of manufacture of claim 64, wherein an object is not recovered
2 when the unit of recovery accessing that object ends before the target time and there are no
3 pending writes for the object.

1 66. The article of manufacture of claim 65, wherein the unit of recovery begins
2 and ends before a checkpoint time, and wherein the checkpoint time occurs before the target
3 time.

1 67. The article of manufacture of claim 65, wherein the unit of recovery begins
2 before a checkpoint time, and wherein the unit of recovery ends after the checkpoint time but
3 before the target time.

1 68. The article of manufacture of claim 65, wherein the unit of recovery begins
2 after a checkpoint time, and wherein the unit of recovery ends before the target time.

1 69. The article of manufacture of claim 64, wherein an object is recovered if the
2 unit of recovery begins before the target time, and wherein the unit of recovery ends after the
3 target time but before a current time, wherein the current time represents when object data is
4 recorded to the database.

1 70. The article of manufacture of claim 69, wherein the unit of recovery begins
2 before a checkpoint time.

1 71. The article of manufacture of claim 69, wherein the unit of recovery begins
2 after a checkpoint time but before the target time.

1 72. The article of manufacture of claim 64, wherein an object is recovered if the
2 unit of recovery begins after the target time, and wherein the unit of recovery ends before a
3 current time, wherein the current time represents when object data is recorded to the
4 database.

1 73. The article of manufacture of claim 61, wherein a backup is taken.

1 74. The article of manufacture of claim 73, wherein the backup occurs prior to the
2 target time and further comprising restoring data without restoring the database log.

1 75. The article of manufacture of claim 73, wherein the backup occurs after the
2 target time and further comprising restoring data and optionally restoring the database log.

1 76. The article of manufacture of claim 73, further comprising restarting the
2 database system with a conditional restart with defer all option.

1 77. The article of manufacture of claim 61, further comprising flushing cache data
2 to disk.

1 78. The article of manufacture of claim 61, further comprising truncating the
2 database log at the target time.

1 79. The article of manufacture of claim 78, further comprising disabling access to
2 the database and restarting the database system, wherein restarting detects uncommitted units
3 of recovery.

1 80. The article of manufacture of claim 79, further comprising creating a
2 compensation log and appending the compensation log to the truncated database log
3 beginning from the target time.

1 81. The article of manufacture of claim 61, further comprising restoring the
2 identified objects.

1 82. The article of manufacture of claim 81, further comprising determining
2 whether the database log should be applied to the restored objects to update the identified
3 objects with current object data.

1 83. The article of manufacture of claim 82, when the determination is made to
2 apply the database log to the identified objects, further comprising optimizing the identified
3 objects such that the identified objects may be restored without applying the database log to
4 the identified objects.

1 84. The article of manufacture of claim 83, if the objects can not be optimized,
2 applying the database log to the restored objects.

1 85. The article of manufacture of claim 81, after restoring the identified objects,
2 further comprising providing access to the identified objects.

1 86. The article of manufacture of claim 61, further comprising optimizing the
2 identified objects by restoring a volume of the datastore and recovering corresponding
3 objects.

1 87. The article of manufacture of claim 61, further comprising optimizing the
2 identified objects by grouping the identified objects, wherein the grouped objects have
3 backups residing on the same volume of the datastore.

1 88. The article of manufacture of claim 61, wherein an object is associated with
2 different units of recovery, wherein one or more units of recovery require different levels of
3 processing, and wherein the object is recovered utilizing the highest level of processing.

1 89. The article of manufacture of claim 61, wherein the one or more individual
2 objects to be recovered to a target time are recovered from a current time.

1 90. The article of manufacture of claim 79, wherein the current time represents at
2 time at which the database system crashed.